
State of Tennessee
THE GREAT SEAL OF THE STATE OF TENNESSEE
XVI
AGRICULTURE
COMMERCE
1796

Envision a New World of Design & Construction Excellence

Developing and Operating High Performance Buildings and Project Teams

Office of the State Architect

State of Tennessee
DRAFT Research
regarding
Multi-year Strategy for Improving Performance of Projects and Project Teams

presented by

Bob Oglesby, AIA, LEED AP
State Architect
Office of the State Architect (OSA)

DRAFT

September 2012

Role of the State Architect

Provide operational and technical staff support to the State Building Commission (SBC) which approves funding for all projects associated with improvements to real property

SBC's chief staff officer responsible for implementing its by-laws, policies and procedures

Assist SBC in making informed and timely decisions

SBC's responsible party for recommending, then developing and implementing SBC approved initiatives, programs and policies

- facilitated through the three **S**tate **P**rocurement **A**gencies (**SPA**s) – DGS's STREAM, TBR and UT
- assisting SPAs so their projects are expeditiously approved and delivered efficiently and responsibly

One of OSA's goals is to be strategic and develop a long term vision to be implemented in phases over a multi-year time frame for SPAs to roll out

SBC continues to be interested in considering any items which may achieve a higher and better use of taxpayer dollars spent on improvements to real property

I research and recommend for SBC's consideration items I believe may:

- create greater owner value and
- will lower the State's total cost of ownership through
  - more efficient and effective design, construction and operational processes
  - the realization of higher performing buildings throughout their entire life cycle

This presentation includes referenced data from 3rd party sources for the purpose of presenting research and development data to the SBC prior to their consideration for any possible future action.

Before bringing any new initiatives forward requires great efforts and thought especially when it requires and involves private industry.

There are currently no plans or timetable to request action on any future items being presented herein.

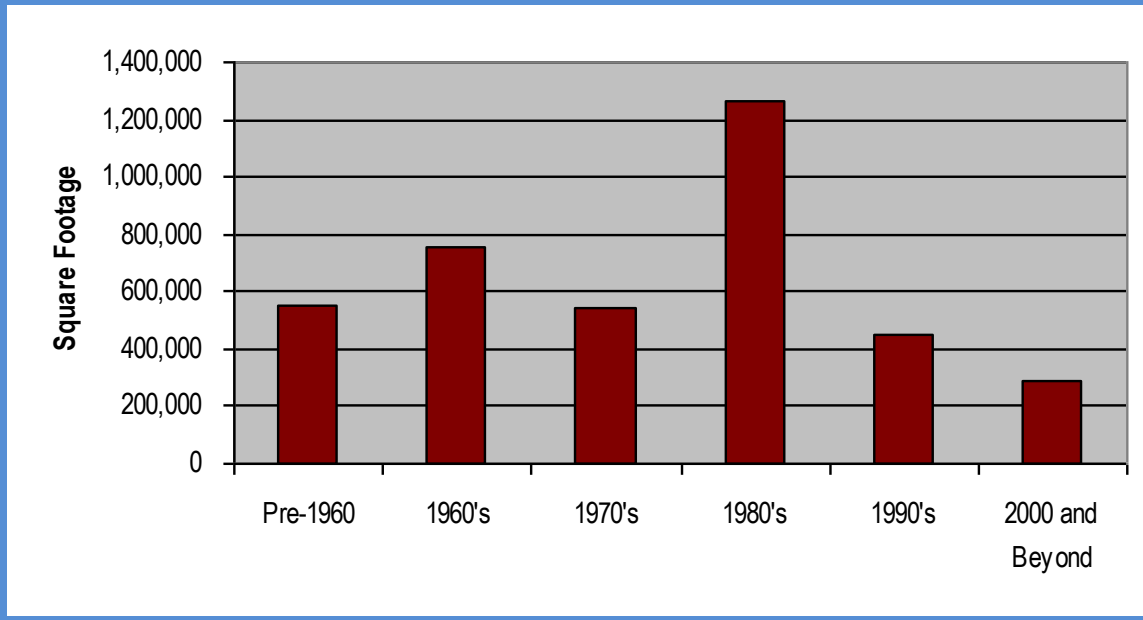
1. It costs too much to operate and maintain our buildings

FY 11/12 FRF (General Government General Office Buildings) Spend Analysis

	Above Industry Standards
Utilities costs	30+%
Repairs and Maintenance costs	63+%

Current FRF Buildings

- Average Age of Owned Portfolio is 35 years
- The oldest 43% of the portfolio has an average age of 50 years
- Architecture and technology have surpassed current portfolio



Chattanooga State Office Building
Built 1955

Donnelley J. Hill
Built 1968

Lowell Thomas State Office Building
Built 1977

Citizen's Plaza
Built 1986

Davy Crockett
Built 1989

Developing more High Performing Buildings (HPB)

- Higher Performing Buildings (HPB) are buildings with lower total costs of ownership and longer useful lives
- There is an increased appreciation by owners and the AEC industry regarding the benefits of High Performance Buildings (including but not limited to lower life cycle costs including utility and operations costs)
- Utilizing highly collaborative integrated project delivery methods on those projects often lends itself well to advancing the delivering of higher performing buildings

High Performance Building (HPB) Design

- Requires a holistic approach to design and construction which
  - Considers a building's energy load as a whole
  - Integrates energy-efficient measures in order to
    - Reduce demand
    - Reduce off-site generated energy consumption and
    - Results in a high quality product that maximizes the owner's return on investment and reduces their total cost of ownership (life cycle costing vs first cost)

High Performance Building Design (continued)

- Includes all players in some form of an highly collaborative Integrated Project Delivery (IPD) type process to create a higher performing project team
    - Owner
    - Design team (a/e)
    - Construction team (materials manufacturers, contractors, waste managers)
    - Operating / maintenance staff
- Highly collaborative methods often include: CM/GC, Design-Build, and Integrated Project Delivery
- Often utilizes Building Information Modeling (BIM) as a tool to reach a higher level of project and team performance

High Performance Building Design (continued)

- Example Opportunities
  - Day lighting can reduce lighting energy use by 50-80% typically which thus reduces the mechanical cooling requirements
  - Water efficient techniques can reduce usage by 30% or more
  - Fundamental Commissioning
    - Energy savings - 5-10%, min 3:1 payback by end of 1st year of operation
    - Costs - .2 – 2.5% additional construction cost
  - Proactive, collaborative design solutions with the assistance of energy modeling and monitoring can often additionally reduce energy consumption - totaling 20-50%
  - Improved Indoor Air Quality (IAQ) can increase human health, well-being, and performance (est. up to 16%)

According to a 2002 EPA report, ENERGY STAR - labeled office buildings generate utility bills 40% less than the average office building.

New construction high performance corporate headquarters are reporting significant

- Reductions in absenteeism / sick days (example: 15% at Lockheed Martin in CA)
- Increases in productivity ranging from 6 – 26% (from Rocky Mountain Institute)
- Features include: access to pleasant outdoor views, increased daylight, fresh air, and personal light and temperature controls

In Summary

- Even with possibly higher first costs for construction of certain high performance building features, these costs are typically recovered within a reasonable payback period.
- Integrated project delivery methods utilizing a multidisciplinary team approach will reduce first and ongoing operating costs
- Specific project team actions should include:
  - Setting and prioritizing high performance goals in each project's definition, and including those goals in the designer and contractor selection processes
  - Budgeting for any higher first costs
  - Basing decisions on life-cycle cost analyses (LCCA)
  - Using energy modeling to inform the design

- By making the right decisions during design and construction, reductions in operation and maintenance costs can be realized – often with little or not additional up-front costs
- 2003 State of California commissioned "The Costs and Financial Benefits of Green Buildings" concluded "that minimal increases in upfront costs of about 2 percent would, on average, result in life cycle savings of 20 percent of total construction costs
  - Example - $10,000 up-front investment on a $5 mil project would result in a savings of $1 mil in today's dollars over the life of the building"
- Federal government's GSA now "requires all new-construction and major modernization projects to be certified through the LEED program, with an emphasis on obtaining Silver ratings."
  - New budget allocations (typically varying between 2.5 and 4.0%) are enough to ensure this can be achieved and project teams are encouraged to achieve the highest level of LEED rating that is practical within the overall budget.
    - This range of estimated construction cost impact for LEED certified, Silver and Gold targeted projects falls below the normal 10+% concept phase estimating accuracy

Better buildings equate to better employee productivity

- Better engineering systems, etc. enhance occupant health and well being
- Healthier buildings and occupants can increase human productivity and reduce liability

Envision the State's portfolio if one day:

- The majority of projects were designed, built or renovated with the intention of actually lasting 100 years
- When compared to similar projects ten years earlier
    - Cost very little or no more initially to construct or renovate
    - Were highly energy efficient to operate - utilizing 30-50+% less energy on average
    - Were able to be well maintained at significantly lower maintenance costs at rates equal to current industry standards
- The buildings were aesthetically pleasing and functionally designed to
    - add long-lasting cultural value to the area in which they exist and
    - help their inhabitants to be more healthy and productive
    - utilize current technology, engineering systems, and the best work practices of the day
        - resulting in the occupants being more productive and taking fewer sick days

To get to this new future destination, we need to first envision a new design, construction, and operations world where:

- facilities managers, end users, designers, contractors, suppliers, governing officials, etc. are all involved at the start of the design process
- processes are outcome-driven and decisions are not made solely on a first cost basis
- all communications throughout the process are clear, concise, open, and transparent
- designers fully understand the ramifications of their decisions (time, budget, quality, etc.) at the time the decisions are made
- risk and reward are value-based and appropriately balanced among all team members over the life of a project
- the industry delivers a higher quality and higher performing project

2. **Better project and project team leadership and management by Owner representatives will result in better project performance (scope, budget and schedule control) and project team productivity**

There is an increased emphasis on SBC / OSA oversight and SPA leadership and management of project scopes, budgets and use contingency funds to reduce the number of Owner requested scope and budget revisions and related change orders

The State needs to be able to

- more accurately develop project scopes and budgets (consistent with comparable market rates) before budget requests are submitted and project funding is authorized, and
- better lead their projects and better utilize their project team resources to receive greater benefit and value
- better manage those projects to their approved scopes, budgets and schedules

Examples of recent solutions:

- General government's / STREAM's **operational pre-planning** of projects
  - making a business case for each request prior to bringing it forward, as well as
  - to better define project scopes, expectations, and budgets before starting the design and construction process
  - to expedite project approvals, minimize future SBC revision requests, and have tighter project controls
- Furthering the Statewide use of **design and construction pre-planning** of projects to assist in scope definition and budgeting
  - development of a project's design, budget and schedule to the extent necessary for each project's specific needs
  - overlapping this pre-planning work with the budget request cycle thus shortening the time it takes from budget request to occupancy

3. It takes too long to deliver State projects

Recent study conducted internally and confirmed by consultants identified the normal time to

- identify and plan a project,
- request funding and get funding approved, then get project approved,
- select a designer, design the project,
- procure a contractor and construct a 9 month construction duration project
- took at least 39 months

Proposals have been made as to how we can reduce this down to 21 months

- Starting the budget process with an Operational business case for each project in hand
- Overlapping budget process with Project Design and Construction Pre-Planning
- Using integrated project delivery methods over sequential DBB methods when appropriate and the early involvement of contractors during design

"Traditional" Design-Bid-Build (D-B-B) delivery method continues to be most widely used delivery method, especially by the public sector

- Provides competitive bidding environment
- Provides clear separation of designer and contractor responsibilities and liabilities
- Requires the least effort by Owners on the front-end

However, D-B-B can sometimes

- Create adversarial relationships between the designers and contractors
- Award contracts to low bidders that aren't the most qualified
- Result in numerous Change Orders and RFIs
- Not always be the lowest cost method in the end

While D-B-B will remain the best choice on certain projects, many industry experts now realize other methods may be better suited for certain project types and situations

For instance, when a project is such that some or all of the following conditions exist:

- Would benefit from early contractor involvement, and high levels of collaboration between the design and construction team members – when:
    - Scope is not well defined,
    - Budget is not well defined,
    - Schedule needs to be expedited,
    - Complexity level is above average,
    - Striving to achieve higher performance building goals

Summary of report - “Influence of Project Delivery on Sustainable, High Performance Buildings”

- November 2010 University of Colorado research project funded by a grant through the Charles Pankow Foundation

To achieve HPB Goals, project complexity increases as does the demand for increased interdisciplinary collaboration including early involvement of participants, higher levels of communication, and compatibility (trust) between project team members

- Project delivery methods often impact the Owner’s ability to achieve higher levels of building performance
- Studies show Design-Bid-Build (D-B-B) strategies may not address the complex demands found in high performance building projects and actually may actually constrain the contractor’s ability to assist in achieving certain high performance building objectives
- Design team separation from the contractor reduces the opportunity for innovative solutions by the contractor and sub-contractors
- Additionally, the (early or late) timing of contractor involvement also is a key factor affecting a building’s performance

In other words, it is very difficult to achieve high performance building outcomes without some form of integrated design process where the contractor is involved during the design process

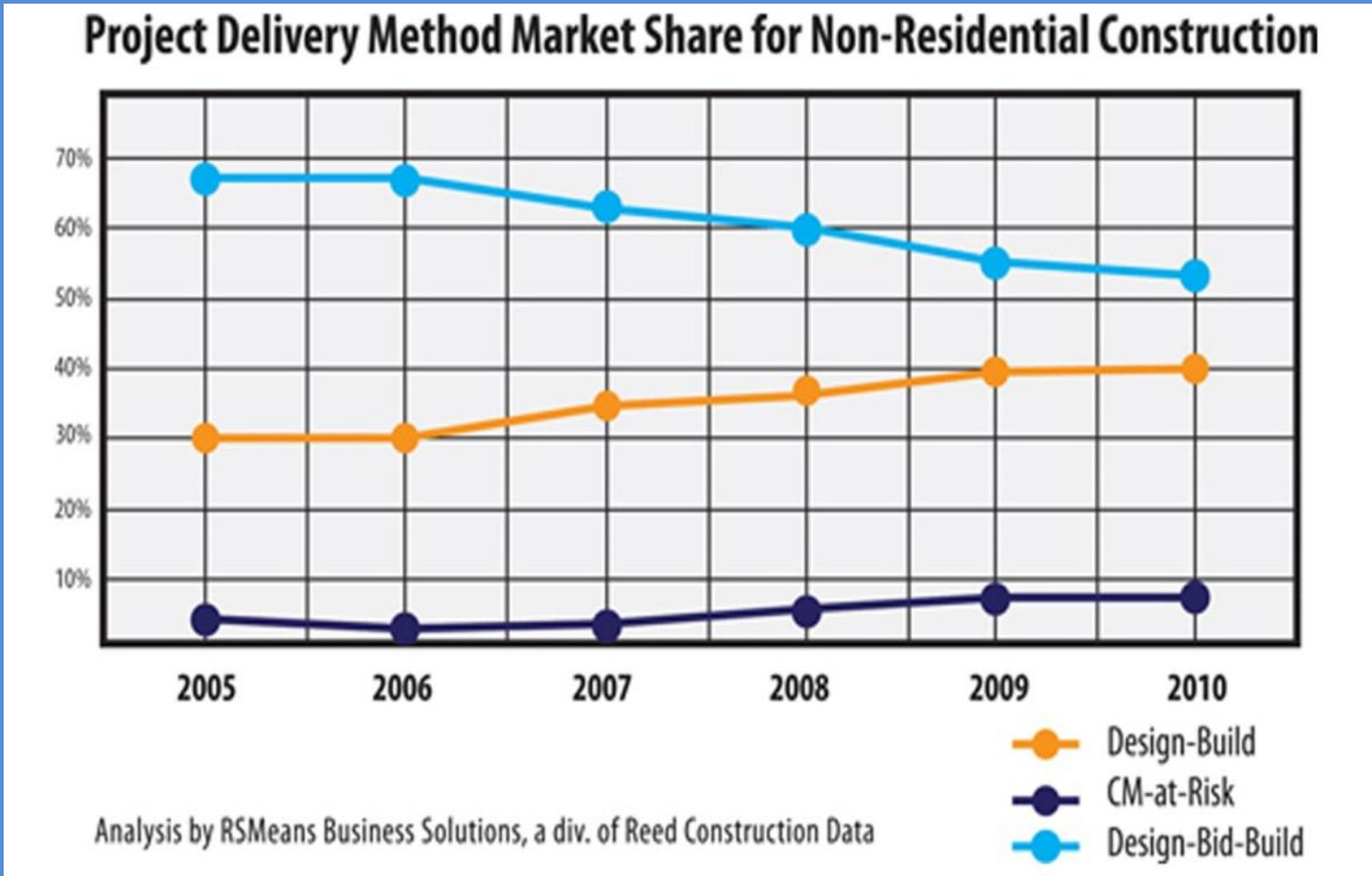
An analysis of Construction Delivery Methods for U.S. Non–residential Vertical Construction

2005

67%
D-B-B

30%
D-B

3%
CM/GC



2010

52%
D-B-B

40%
D-B

8%
CM/GC

OSA's current policy on Alternative Delivery Methods is based on the State's Quality in Construction (QIC) Task Force 's work product.

- QIC was comprised of members from the design and construction industry and various state agencies which engage in building projects and met in 2004/5 and 2009/10

QIC identified various "alternative" delivery methods beyond D-B-B

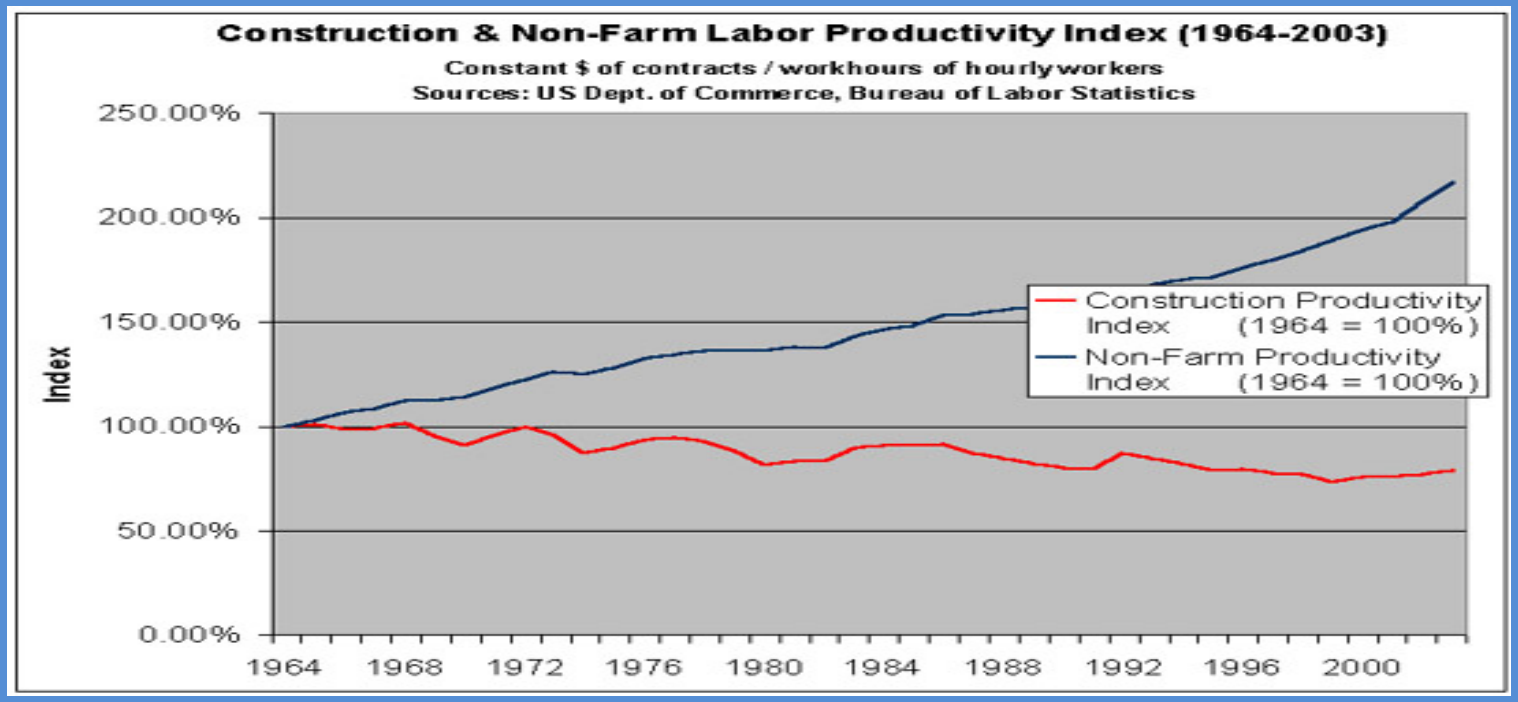
- Best Value 1, 2, and 3 (BV1, BV2, BV3) - requires two part contractor submittal, first creating a short list of qualified bidders whose lowest bid will determine who is awarded the contract
- Construction Manager/General Contractor (CM/GC) - brings a contractor in early in the design process, providing pre-construction services, to work with the designer and owner to contribute to cost estimating, scheduling, and constructability reviews
- Design-Build (D-B) – provides a single point for responsibility by bringing the designer and contractor in at the same time under one contract

It is important to have options as each project has unique characteristics and requirements, so each project team should assess and determine the most appropriate Project Delivery method.

SBC Policy approved the use of these new Alternative Delivery Methods occurred in Dec. 2005

4. **Project Team productivity will typically increase through utilization of best industry practices**

The US Department of Commerce, Bureau of Labor Statistics tracking of the construction industry's productivity



+ 115%

- 30%

As measured by dollars of new construction work / field work hour, labor productivity in the construction industry has trended downward over the past 40 years

- Totaling approx – 30% decrease over the past 40 years

In other words, construction projects have required significantly more field work hours per constant dollar of contract.

Much has been published about the four factors that can positively affect construction productivity.

One of these is:

(1) utilization of technology

Other three factors are:

(2) life-cycle design and construction processes

(3) availability of skilled labor and

(4) use of off-site fabrication and modularization

Utilization of technology, and BIM in particular, has been identified as extremely valuable tool to increase productivity of project teams and improve the quality control of built projects by

- enabling critical communications and collaboration,
- sharing of information between different parties,
    - to achieve high performance building goals
    - throughout a project's total life cycle of design, construction and operations

Additionally, while most other industries are improving their productivity, the construction industry seriously lags other industries in developing labor saving ideas and in finding ways to substitute equipment and technology for labor.

- Despite the fact that there has been a significant adoption of new information technology by the construction industry over the past 35 years, these applications tend to run in a stand-alone mode which does not encourage improved collaboration by other members of the project team.

McGraw Hill Construction's report "The Business Value of BIM" conducted in 2007 and updated in 2009 and numerous other McGraw Hill Construction BIM reports in July 2009

A total of 2, 228 respondents completed the survey

• Architects	598 interviews	27% (97% of which design buildings)
• Engineers	326 interviews	15% (Structural 53%; Civil 27%; M,E, or P 10%)
• Contractors	817 interviews	37% (Mech 25%; General 24%; CM 20%; Estimator 13%)
• Owners	118 interviews	5% (Design and Construction related 80%; Operations / Fac. Mgmt. 10%; Other 10%)
• Building Products	73 interviews	3% (Manufacturers 67%; Distributor 25%)
• Other	296 interviews	13% (Planning firms 5; other 291)

Architects / Engineers

- Large Companies 32% (> $10 mil in annual income)
- Medium to Large 13% ($5 mil to < $10 mil)
- Small to Medium 29% ($500k to < $5 mil)
- Small 25% (<$500k)

Contractors / Owners / Building Products Companies

- Large Companies 32% (> $500 mil in annual income)
- Medium to Large 13% ($100 mil to < $500 mil)
- Small to Medium 29% ($25 mil to < $100 mil)
- Small 25% (<$25 mil)

Level of Expertise using BIM

	TOTAL	Beginner	Moderate	Advanced	Expert
• Large Companies	22%	30%	43%	34%	42%
• Medium to Large	27%	32%	23%	25%	21%
• Small to Medium	20%	24%	21%	27%	21%
• Small	32%	14%	13%	13%	16%
• TOTAL	100%	100%	100%	100%	100%

All industry users surveyed in this report said the top BIM benefits as of 2009 which contribute the most value include:

- Improved collective understanding of design intent
    - Thru 3D visualization and a rich database of project information clients, designers and contractors better understand the virtual design of the building before construction
    - Improved overall quality of the project's construction documents
- During Design - Better cost control / predictability of project scope
- During Construction
    - Reduced number of RFIs (Requests for Information) and Change Orders
    - Reduced conflicts during construction
        - Conflicts in drawings found during construction are costly, and typically adversely affect both budget and schedule
        - Reducing conflicts rewards the entire project team - architects, engineers, contractors and the Owner
        - Faster project delivery

The top BIM benefits anticipated in 2009 to contribute the most value by 2014 include:

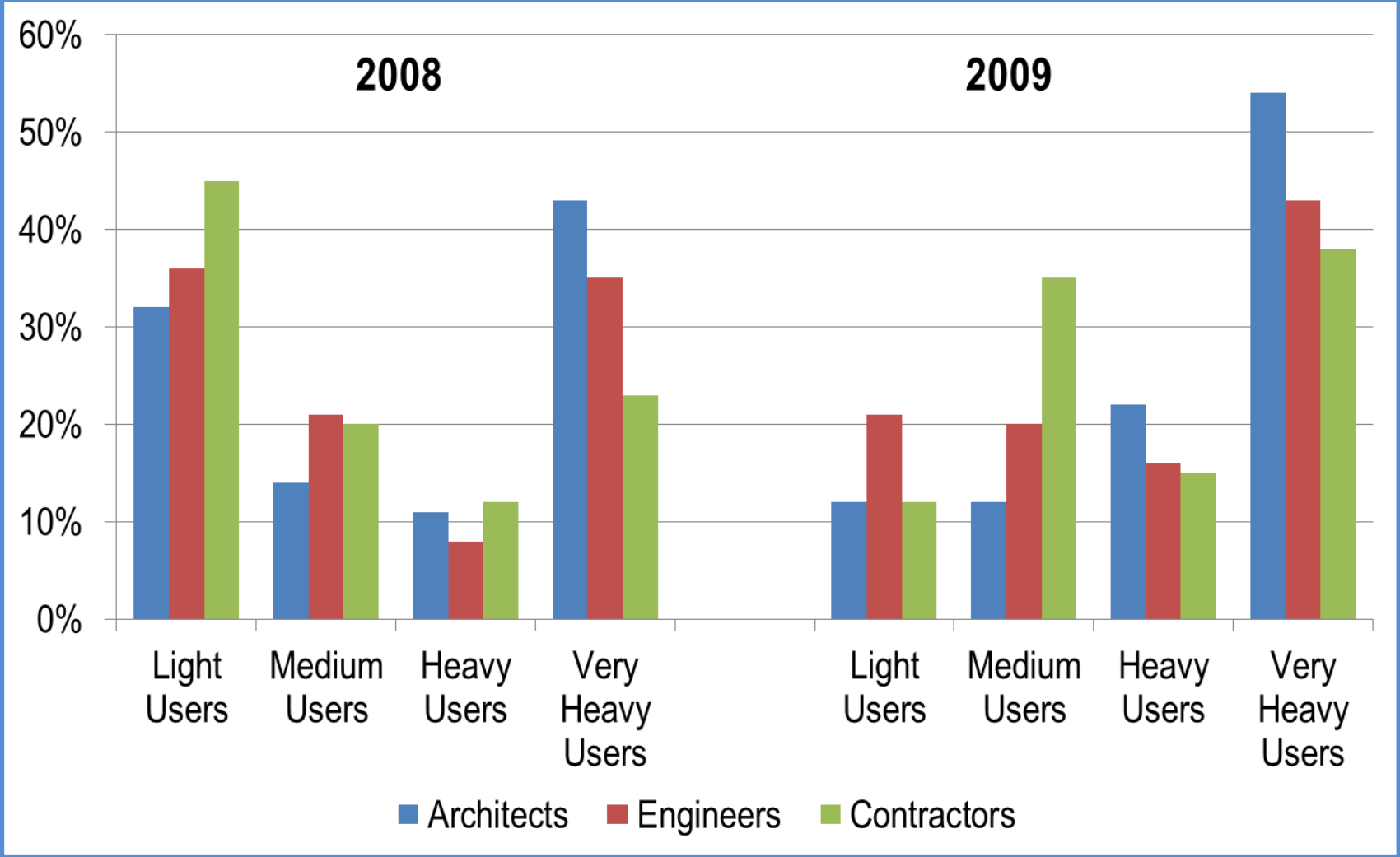
- Better designed projects
- Lower risk and better predictability of outcomes
- Prefabrication of larger, more complex parts of projects
- Reduced claims, disputes and conflicts
- Better performing buildings / infrastructure
- Faster delivery schedules
- Enhanced operations, maintenance, and facility management
- Lower construction costs
- Safer construction processes and sites

Regarding AEC industry adoption of BIM

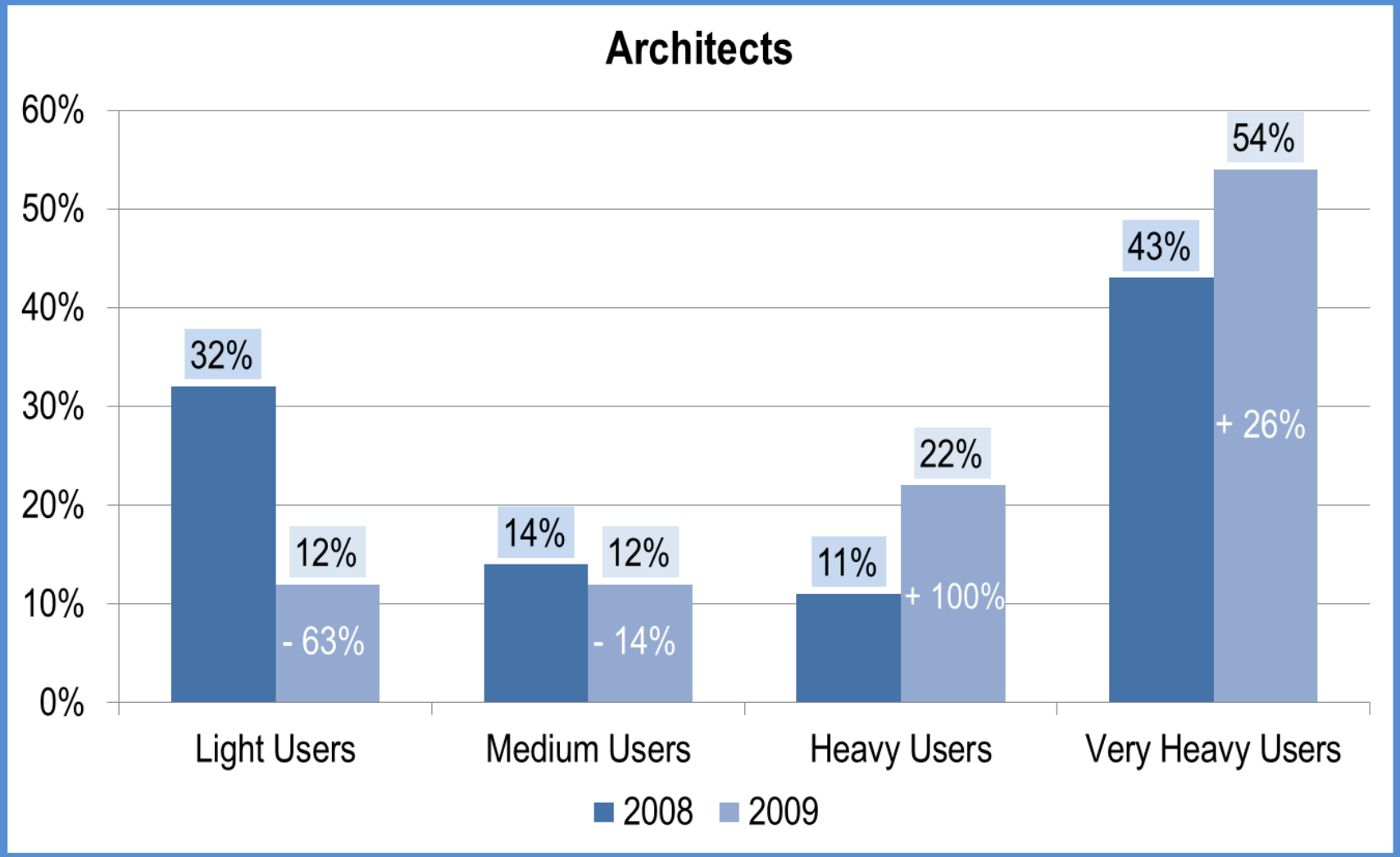
Fastest growing market segments adopting BIM as of 2009

- Public Work 35%
- Health Care 28%
- Education 24%
- Private and other 13%

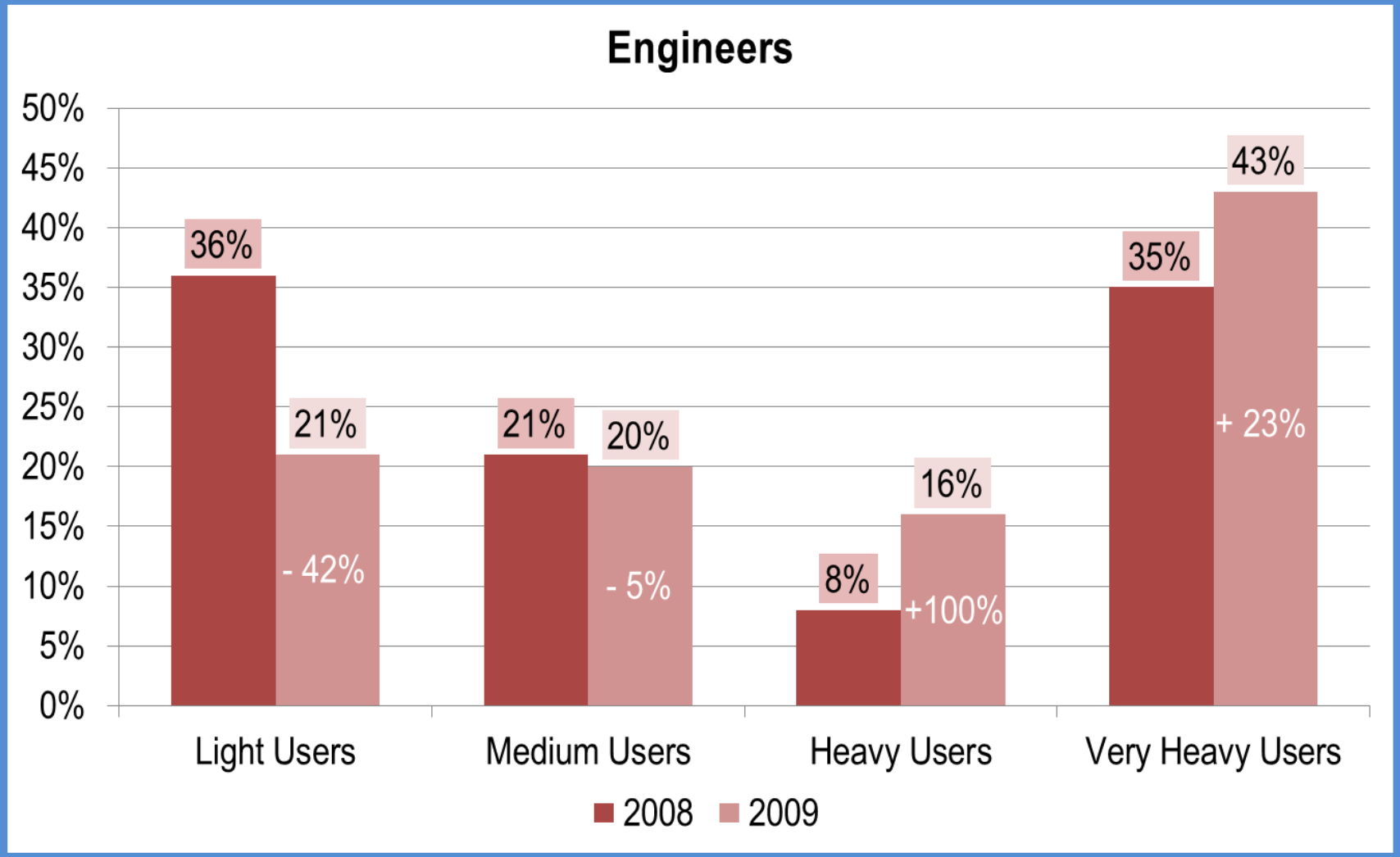
Growth in BIM Use on Projects



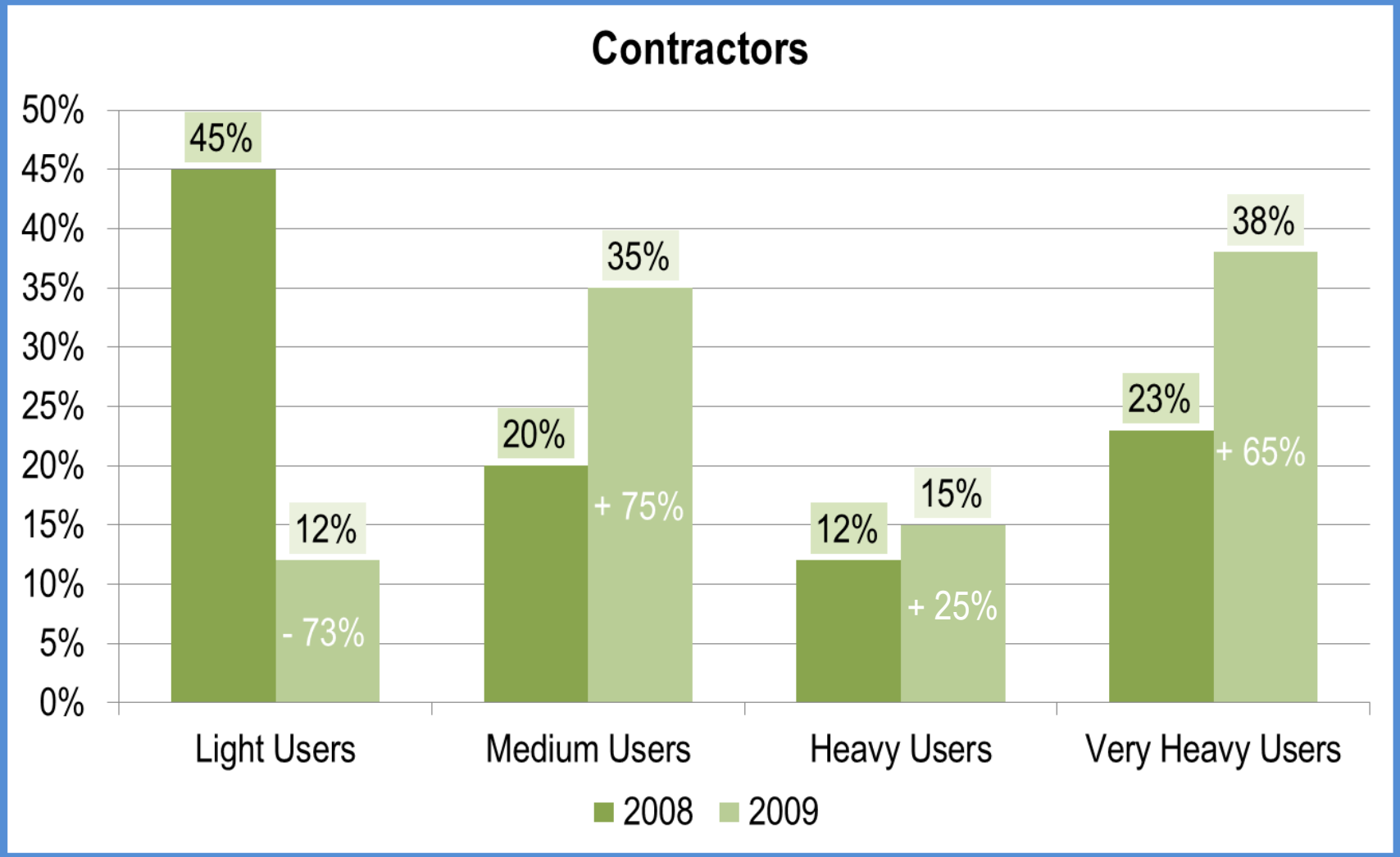
Growth in BIM Use on Projects



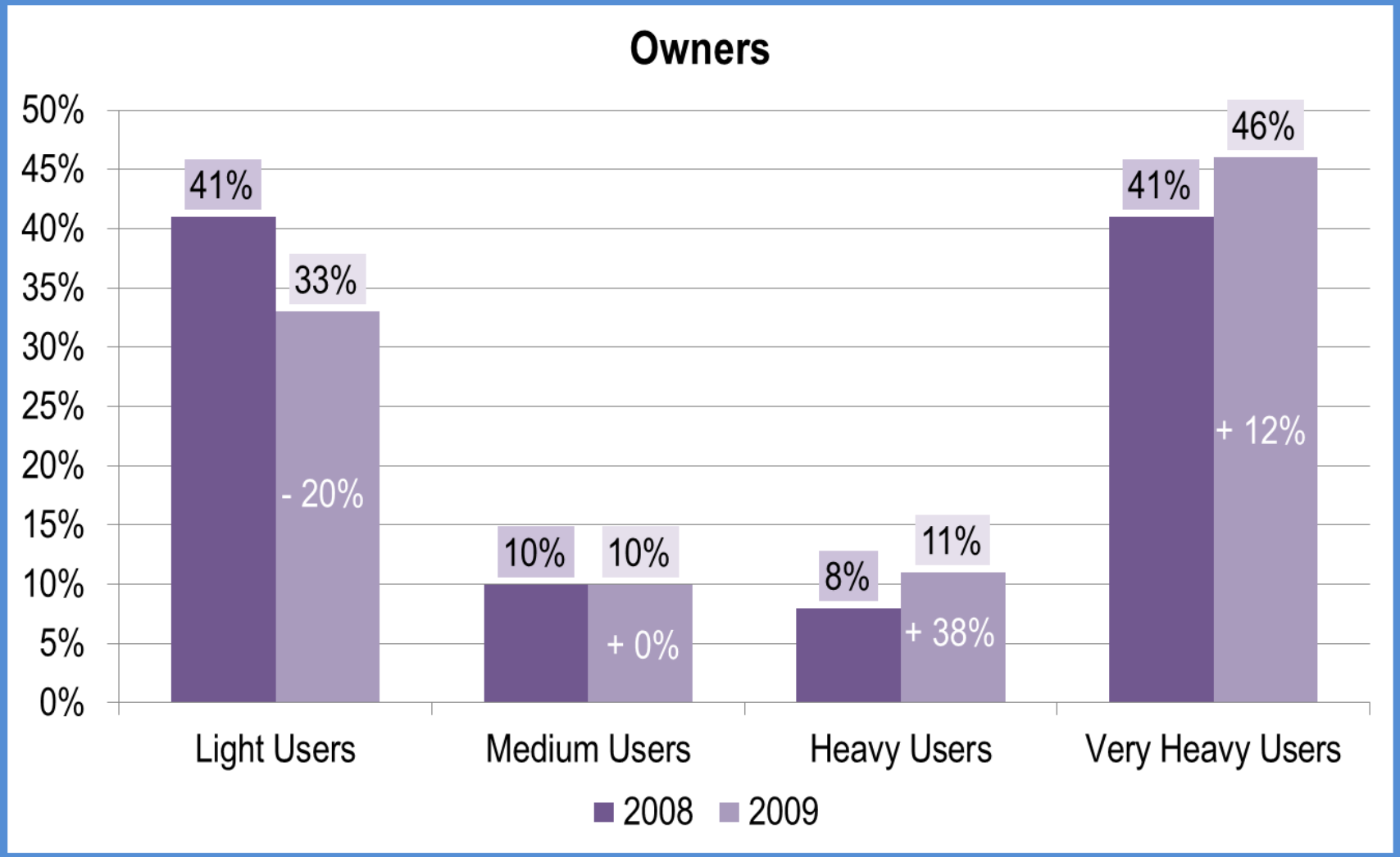
Growth in BIM Use on Projects



Growth in BIM Use on Projects



Growth in BIM Use on Projects



So where is the State in regards to investigating opportunities to address these items?

1) The SPAs are already looking at utilizing “alternative” delivery methods more often on some of their projects where appropriate

2) My office has selected a High Performance Building consultant - SSRCx of Nashville. Their scope includes developing recommendations for consideration of such tasks as:

    - Return on Investment (ROI) policies
    - Life Cycle Cost Analysis models
    - Energy Modeling requirements
    - HPB Performance Specifications
    - Facility (Post Occupancy) Performance Evaluations/Metrics
    - Updating our Sustainable Design Guidelines (minimum project requirements)

Beyond that there are no definitive plans or SBC approvals to implement any new levels of HPB minimum requirements at this time. This initiative would provide the guidance for well informed decisions if and when any new policies are put in-place in the future.

3) My office has also selected a BIM / Virtual Design & Construction consultant - Kristine Fallon Associates of Chicago. Their scope will focus on developing recommendations for consideration of design, construction, and operations/facility management phase related items.

Anticipated Scope of Work includes:

- Creating a Common Understanding and Vision of the potential use and benefits of BIM / VDC from an Owner's point of view.
    - There is a kickoff presentation and webcast (for the first 99 people logged in) by our consultant on Thursday, September 27 beginning at 1:00 cst. Be sure and connect prior to 1:00.
    - The url for the presentation is https://stateoftn.adobeconnect.com/bimtownhall.
    - The on-site presentation is being held in the TN Tower Tennessee Room on the Third Floor
    - The presentation is being recorded and will be viewable on demand from our website afterwards
- Identifying and developing draft BIM requirements and standards for voluntary pilot projects

- Gap analysis – reviewing and proposing recommendations for change of such items as:
  - Contract language and deliverables
  - Designer Manuals and other contract related documents
  - Fee Schedules
  - BIM Standards
- Audit of voluntary pilot projects
- Additional Gap Analysis
  - Recommend additional changes
  - Identify Owner post construction use opportunities
  - Develop recommendations for interfaces and integrations with other State systems (Project Management, GIS, etc.)

As with the HPB, there are no definitive plans or SBC approvals to require use of BIM on State of TN projects at this time. If and when the State decides to do so, this consultant's work will provide necessary tools for success.

Questions for the Audience

Construction Delivery Methods

1. Is your office's total volume of project construction delivery methods above the stated industry average for each of the following delivery methods?
    - 53% with D-B-B (including Best Value)
    - 41% with D-B
    - 6% with CM/GC

2. How many of you would encourage the State to consider expanding the use of alternative delivery methods (integrated design and construction team approach) in addition to using D-B-B when appropriate? Project delivery methods include:
    - B-V
    - CM/GC
    - IPD

3. Considering the delivery methods listed below,
    - D-B-B
    - Best Value
    - CM/GC
    - Direct-Construct (limited to no designer / documents)
    - Design-Build (full design documents)
    - IPD

    Would you expect the D-B-B delivery method will most often result in the least
    a. Number of RFIs?
    b. Number of Change Orders?
    c. Number of time delays?
    d. Cost of construction?
    e. Cost of operations?

4. How many of you believe that more integrated design and construction team alternative delivery methods allow for better
    a. Final design and constructed solutions?
    b. Higher performing buildings?

High Performing Building Designs

5. How many of your offices are providing high performing building designs to 60% or more of your clients whether requested by them or not?

6. How many of you believe that high performing building designs can lower the total cost of ownership (utility, operating and maintenance costs)?

Building Information Modeling

7. How many of you are using BIM on a daily basis in your office?

8. How many of you would generally support a public Owner's requirement for a project team's design and construction phase use of BIM?

9. If you are using BIM on a daily basis in your office, how many of you:
    a. Are using BIM on 60% or more of your projects of the descriptions provided in the previous question?

10. How many of you believe a design team's use of BIM will more often than not result in achieving a higher level of
    a. construction quality?
    b. building performance (lower utility, operating and maintenance costs)?

11. How many of you believe the Owner's use of the project's design and construction team's BIM data will more often than not result in achieving more effective owner provided operations, facilities management, etc. over a building's life cycle?

12. How many of you using BIM believe it
    a. Improves collective understanding of design intent?
    b. Reduces changes associated with coordination conflicts during construction?
    c. Improves overall quality of construction documents?
    d. Provides useful owner data for post construction use during the building's life cycle?
    e. Improves coordination of drawings?

13. How many are using BIM on projects for the
    a. Private sector?
    b. Public sector?

Questions?